

A New Species of *Okenia* (Gastropoda: Nudibranchia: Goniodorididae) from the Pacific Coast of Costa Rica

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A new species of opisthobranch mollusk of the genus *Okenia* is described from the Pacific Coast of Costa Rica. *Okenia academica* sp. nov. has a translucent gray-brown body, and short dorsal tubercles, nine pairs of mantle processes which are white in color with orange to brick red apices. The species is compared to other species from the Panamic Province and the West coast of North America. This is the first record of the genus for the Pacific Coast of Costa Rica.

Key words: Mollusk, Nudibranchia, Costa Rica, *Okenia*.

RESUMEN

Una nueva especie de molusco opisthobranquio del género *Okenia* es descrito de la costa pacífica de Costa Rica. *Okenia academica* sp. nov. tiene un cuerpo gris cafésuzco traslúcido, nueve procesos en el manto, blancos en color con ápices anaranjados o rojo ladrillo y tubérculos cortos presentes en el dorso. La especie es comparada con otras especies de la Provincia Panámica y la costa Oeste de Norte América. Este es el primer registro del género para la costa pacífica de Costa Rica.

The genus *Okenia* Menke, 1830 consists of 10 species found primarily along the Pacific Coast of the Americas: *Okenia vancouverensis* O'Donoghue, 1921 from Canada, *Okenia plana* Baba, 1960 from California and Japan, *Okenia angelensis* Lance, 1966 from California and México, *Okenia* sp. 1 and *Okenia* sp. 2 (in Behrens 2004) from California, *Okenia luna* Millen, Schrödl, Vargas and Indacochea, 1994 from Perú and Chile, and three other new species from México (Gosliner & Bertsch, 2004). Another species, *Hopkinsia rosacea* MacFarland, 1905 has recently been placed within the genus *Okenia* (Gosliner, 2004). The description of the present species is the first report and description of a member of the genus *Okenia* for the Pacific Coast of Central America.

SPECIES DESCRIPTION

Genus *Okenia* Menke, 1830

Type species: *Doris elegans* Bronn, 1826

***Okenia academica* Camacho-Garcia and Gosliner, sp. nov**

(Figs. 1–3)

TYPE MATERIAL.—HOLOTYPE: Punta San Francisco, Playa Tamarindo, Parque Nacional Las

Baulas, Area de Conservación Tempisque, Costa Rica ($9^{\circ}03'58''\text{N}$, $85^{\circ}51'08''\text{W}$), January 12, 2001, 1 specimen, dissected, 6 mm preserved length, 0 meters depth, leg. J. Magaña (INB0003118102); SEM stub with radula and jaw (INB0003764988); PARATYPES: Punta San Francisco, Playa Tamarindo, Parque Nacional Las Baulas, Area de Conservación Tempisque, Costa Rica ($9^{\circ}03'58''\text{N}$, $85^{\circ}51'08''\text{W}$), January 12, 2001, 1 specimen, dissected, 6 mm preserved length, 0 meters depth, leg. J. Magaña (CASIZ 170030), with the radula mounted on a SEM stub with the same number; San Miguel, Reserva Natural Absoluta de Cabo Blanco, Area de Conservación Tempisque, Costa Rica ($9^{\circ}34'53''\text{N}$, $85^{\circ}08'26''\text{W}$), September 18, 1998, 1 specimen, 3 mm preserved length, 0 meters depth, leg. F. Alvarado (INB0001496648).

GEOGRAPHIC RANGE.— This species is known only from the Pacific Coast of Costa Rica (present study).

ETYMOLOGY.— The species is named after the California Academy of Sciences (CAS) in San Francisco, California to honor its contribution to the inventory of opisthobranch mollusks in Costa Rica and to honor the celebration of its sesquicentennial.

EXTERNAL MORPHOLOGY.—

The body is oval and elongated (Fig 1A–B). The dorsum has as many as 24 small tubercles of different sizes. There are no spicules present on the notum. The head has the form of a bilobed velum (Fig. 2B). The rhinophores are proportionally very long with respect to the length of the animal and curve backwards with about 18 fine lamellae. There are two notal processes above the veil and seven elongated notal papillae on each side of the body that can curl either inward or upward. The last process on each side of the body is much longer and bifid.

The branchial leaves are larger anteriorly. The branchial plume is composed of 10 to 13 unipinnate branchial leaves. The anal papilla is located in the center of the branchial leaves. The viscera are visible through the notum in the anterior part of the body. The prolongation of the pointed foot is visible when the animal is in motion. The foot is simply rounded anteriorly.

The background color of the body is translucent gray-brown.

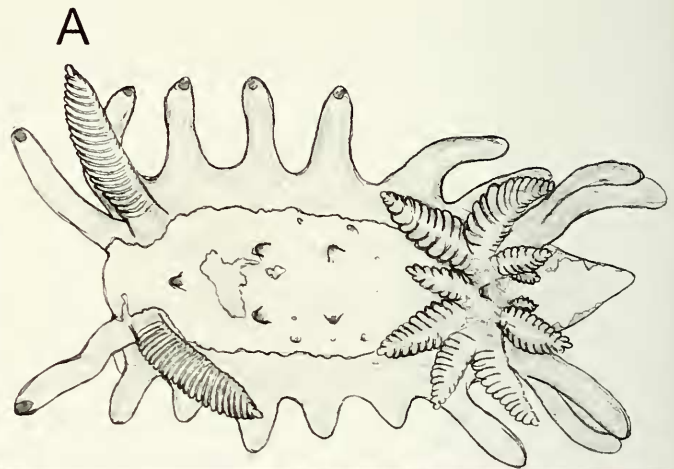


FIGURE 1. A. Drawing of the living animal of *Okenia academica* sp. nov., Costa Rica (INB003118104). B. Photograph of the living animal of *Okenia academica* sp. nov., Costa Rica (INB003118104).

The notum and the greater ventral part of the foot are opaque white. The largest tubercles in the center of the back are reddish brown to reddish orange in color (Fig. 1A–B). The rhinophores and gill range from translucent white to reddish brown with small white opaque spots. The apices of the lateral processes are orange to brick red. The anus is reddish brown. The anterolateral corners of the foot are white translucent with some yellowish spots. Ventrally, the foot is translucent gray.

ANATOMY.— The buccal bulb is large and muscular (Fig. 2A). The buccal pump is large and expands dorsally and posteriorly. A pair of short salivary glands is present adjacent to the entrance of the elongate, thin esophagus. The radular sac descends ventrally from the buccal mass.

The radular formula is $36 \times (1.1.0.1.1)$ in a 6 mm preserved length specimen (Fig 3A). The inner lateral teeth have up to 28 strong denticles on the inner surface of the masticatory border (Fig 3C–D). Each outer lateral tooth has one cusp (Fig 3B). The labial disc is composed of several rectangular jaw elements which are homogeneously distributed (Fig 3E). Each of the jaw elements bears up to six irregular serrations on the outer edges (Fig 3F).

The ampulla is very long and thick. It divides into a short oviduct that enters the female gland mass near the lower right side of the mass and the prostate (Fig. 2C). The prostate is long, tubular

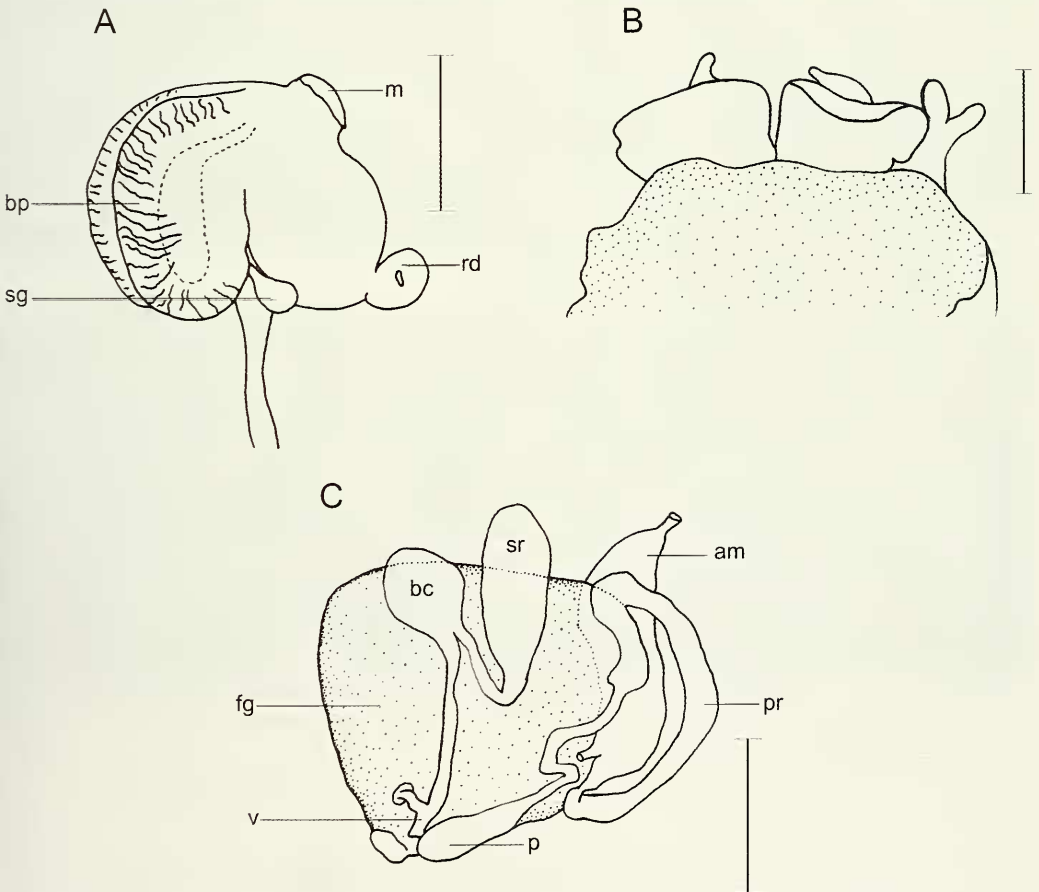


FIGURE 2. A. Buccal mass from right side of *Okenia academica* sp. nov., scale bar= 1 mm. Abbreviations: m= mouth; rd = radular sac; bp= buccal pump; sg = salivary gland. B. Head of *Okenia academica* sp. nov., scale bar= 1 mm. C. Reproductive system of *Okenia academica* sp. nov., scale bar= 1 mm. Abbreviations: am=ampulla, bc=bursa copulatrix, fg=female gland, p= penis, pr=prostate, sr=seminal receptacle, v=vagina.

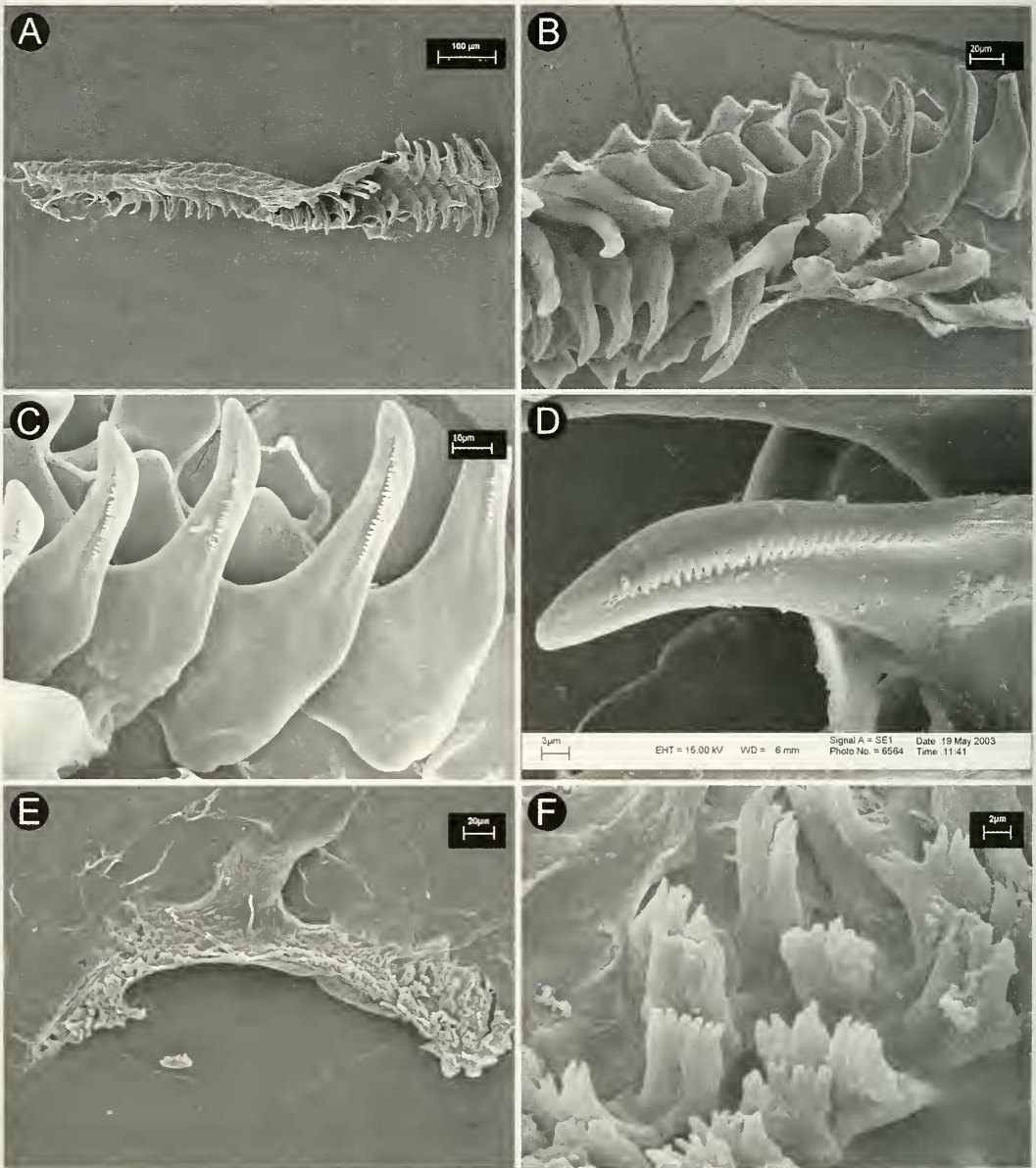


FIGURE 3. Scanning electron micrographs of *Okenia academica* sp. nov. A. Radula (INB003118102). B. Lateral and marginal teeth (INB003118104). C. Detail of the lateral teeth (INB003118104). D. Detail of the denticles of a lateral tooth (INB003118102). E. Jaw (INB003118102). F. Detail of the jaw elements showing the serrated edge (INB003118102).

and convoluted near the middle section. It constricts into a thin, tubular and muscular vas deferens that forms a slight loop into itself. The distal part of the vas deferens is inside a pear-shaped penis. No penial spines were observed in the slide preparation of the penis. The vagina is very long. Near its base, the uterine duct branches and enters the female gland mass. More proximally, it enters the oval bursa copulatrix. A shorter duct emerges from the base of the bursa copulatrix and leads to an

oval and elongate seminal receptacle. The seminal receptacle is twice as large as the bursa copulatrix.

REMARKS.—The seven species of *Okenia* known to inhabit the Pacific Coast of North America have been reviewed recently (Gosliner and Bertsch 2004), this review included three new species. Of the four species that had already been described, *O. rosacea* (MacFarland, 1905), and *O. plana* Baba, 1960, differ from the present species in lacking a distinct lateral side of the body separate from the notum and foot. *Okenia vancouverensis* (O'Donoghue, 1921) differs from *O. academica* in its external body color, being brown with opaque white spots and in having shorter lateral papillae. *Okenia angelensis* Lance, 1966, has an elongate body with a yellowish color ornamented with brown spots. It has only two to three rhinophoral lamellae in contrast to the 18 found in *O. academica*. The three new Mexican species also differ from *O. academica*. *Okenia cochimi* Gosliner and Bertsch, 2004, has a uniformly yellow body color with a single elongate medial notal papilla anterior to the gill. *Okenia mexicorum* Gosliner and Bertsch, 2004, is opaque white with red markings and also has a single medial notal papilla anterior to the gill. (See also Table 1 for summary of diagnostic characters.)

The species that is most similar to *O. academica* is *Okenia angelica* Gosliner and Bertsch, 2004. Externally this species is similar in that it has a broad body with elongate lateral papillae and low tubercles on the notum. The two posteriormost pairs of papillae also originate from a common base in both species and both have a bilobed velum. However, there are significant differences as well. In *O. angelica*, the margins of the notum, foot, bases of the rhinophores, lateral papillae, tubercles, and gills are all covered with dark purple pigment. The middle of the notum is covered by opaque white as in *O. academica*, but the opaque white covers much less of the notal surface in *O. angelica*. In *O. angelica*, the lateral papillae are covered with light, opaque orange-white pigment and lack the darker orange apices of *O. academica*. Internally, the two species have similarly shaped radular teeth and jaw plates. The radula of *O. academica* contains 36 rows of radular teeth in a 6 mm specimen, while a 12 mm specimen of *O. angelica* had only 25 rows of teeth. The inner lateral teeth of *O. angelica* have a more elongate, acutely pointed cusp and have a few more denticles that are more widely spaced than are those of *O. academica*. The most significant differences between the two species are found in the morphology of the reproductive system. In *O. academica* the uterine duct emerges from near the base of the vagina, while in *O. angelica*, it emerges from the top of the vaginal duct at the base of the bursa copulatrix and receptaculum seminis. In *O. academica*, the receptaculum seminis is larger than the bursa copulatrix, while in *O. angelica*, the bursa is larger. In *O. academica* the prostate is much longer than the ejaculatory portion of the vas deferens, while in *O. angelica* the prostate is very short and the ejaculatory segment is very long. The penial sac of *O. academica* is wider than the ejaculatory duct, while in *O. angelica* they are about the same width.

Okenia luna Millen, Schrödl, Vargas and Indacochea, 1994 can be differentiated from *O. academica* externally by the number and color of the mantle processes, which are white with orange to brick red apices and the presence of several tubercles or papillae on the notum, and a notched foot. *Okenia luna* is characterized by a smooth dorsum, a white body with yellow markings, unnotched foot, and flat, triangle-shaped oral tentacles.

ACKNOWLEDGMENTS

This research was made possible by the Cooperative Agreement between the Ministry of Environment and Energy (MINAE) and Instituto Nacional de Biodiversidad (INBio). The fieldwork in Costa Rica was funded by the INBio through the Netherlands Government and the project

TABLE 1. Comparative morphology of the valid species of the genus *Okenia* from the Panamic Province and

<i>Species</i>	<i>Description source</i>	<i>Distribution</i>	<i>Dorsal color</i>	<i>Ventral color</i>	<i>Velar appendages per side</i>
<i>Okenia rosacea</i> (MacFarland, 1905)	MacFarland 1905; Gosliner, 2004	Oregon to Isla San Martín Baja Calif	rose pink	pink	twelve, pink
<i>Okenia vancouverensis</i> O'Donoghue, 1921	O'Donoghue, 1921; Gosliner and Bertsch, 2004	Canada	Brownish with opaque white spots and opaque white medial line on foot	unknown	one, same color as the body
<i>Okenia plana</i> Baba, 1960	Baba, 1960; Rudman and Darvell, 1990; Bouchet and Ortea, 1993; Gosliner, 2004	Japan, Philippines, Hong Kong, New Zealand, Australia, introduced into California	translucent yellowish white, small brown spots	translucent white	one, speckled with dark brown
<i>Okenia angelensis</i> Lance, 1966	Lance, 1966; Behrens, 1991 and Muñoz et.al. 1996; Schrödl, 2003	California to Chile	translucent white flecked with small yellowish and white granules. Reddish brown and green spots also present	sparsely speckled w/light yellow & white	one, white
<i>Okenia luna</i> Millen, Schrödl, Vargas, and Indacochea 1994	Millen, Schrödl, Vargas, and Indacochea 1994; Schrödl, 2003	Perú and Chile	hyaline white with a mid-dorsal stripe of yellow spots	hyaline white usually without pigment	one, yellow
<i>Okenia angelica</i> Gosliner and Bertsch, 2004	Gosliner and Bertsch, 2004	Bahía de Los Angeles to Bahía Banderas, México	deep purplish with opaque white on the center of the notum	translucent white	two, with white apices
<i>Okenia cochimi</i> Gosliner and Bertsch, 2004	Gosliner and Bertsch, 2004	Isla Cedros to Bahía Ballena, México	uniformly lemon yellow	translucent white	one, lemon yellow
<i>Okenia mexicorum</i> Gosliner and Bertsch, 2004	Gosliner and Bertsch, 2004; Behrens, 1991	Baja California Sur to Bahía de Banderas, Jalisco	opaque white patch with reddish brown patches	translucent white	two, reddish brown
<i>Okenia academica</i> Camacho-García and Gosliner, sp. nov.	present paper	Costa Rica	translucent gray-brown	translucent gray	one, with orange to brick red apices

Note: P=present; A=absent; N=notched; U=unnotched

“Development of Biodiversity Knowledge and Sustainable Use in Costa Rica.” This paper is supported in part by the National Science Foundation through the PEET grant DEB-9978155, “Phylogenetic systematics of dorid nudibranchs,” to Terrence M. Gosliner and Ángel Valdés and the California Academy of Sciences. Ángel Valdés made the drawing of the specimens from Costa Rica and Maribel Zúñiga helped with some technical aspects of the paper. David Butvill made constructive comments on this manuscript.

from Western North America.

<i>Mantle processes per side</i>	<i>Rhinophoral bases</i>	<i>Branchial leaves</i>	<i>Dorsal papillae</i>	<i>Oral tentacles</i>	<i>Foot</i>	<i>Cusps of outer lateral teeth</i>	<i>Jaws</i>	<i>Radula</i>
numerous, pink	reddish pink	reddish pink	numerous, pink	A	N	reduced to a small plate	P, short	16-22 x (1.1.0.1.1)
9-10 pairs laterally	same color as the body	same color as the body	P, 24 papillae on the notum	P, digitiform rounded tips	U, broad	one single prominent cusp	P	32 x (1.1.0.1.1)
4, speckled in dark brown	translucent white	translucent white with dark brown specks	P, one medial with brown specks	A	N	two cusps, occasionally with 2-3 smaller denticles	P, regular rounded	21-29 x (1.1.0.1.1)
6-7, white	white w/yellow & white specks at distal end; brown specks near base	white with yellow and brown flecks	P, five or six	P, pointed and fleshy	U	two prominent cusps	A, no distinct jaw plates	21 x (1.1.0.1.1) 19 x (1.1.0.1.1)
8-10, yellow	hyaline white bases, cream leaves w/opaque white pigment	hyaline white with a yellow streak	A	P, broad, flattened triangles	U	one small cusp	P, rectangular with six serrations	23-27 x (1.1.0.1.1)
6-7 w/white apices	purple	with dark brown apices	P, many rounded tubercles, brown in color	P, broad	U	no distinct cusp	P, rectangular with 2-4 serrations	25 x (1.1.0.1.1)
4-7 w/lemon apices	lemon yellow	lemon yellow	P, 1 medial lemon yellow	P, rounded	U	one single and curved	P, small irregular polygonal plates	13 x (1.1.0.1.1)
6-9 reddish brown, some w/opaque white apices	white	translucent white with reddish brown pigment	P, one medial reddish brown with white apex	P, rounded	U	one single and curved	P, very weakly developed	15 x (1.1.0.1.1)
7 w/orange to brick red apices	translucent with small white opaque spots or very dark reddish brown color	translucent w/small white opaque or dark reddish brown spots	P, reddish brown to reddish orange in color	P, broad	U	one small cusp	P, rectangular with six serrations	36 x (1.1.0.1.1)

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